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NATURAL IMPULSES.

By W. Bernhardt.

There is a mystery existing in nature, inaccessible to human reasoning, as scarcely another one, although the phenomena connected with it are among the best known to us and of daily occurrence. When comparing a grain of mustard seed and one of poppy seed we even with the help of a magnifying glass cannot detect anatomical differences of any concern. Each of them encloses two cotyledons, i. e., the first leaves developing in germination ; moreover, it contains a radicle and the beginning of a stem, both located between the cotyledons. Structure and appearance of these primitive organs are very similar in both seeds, and yet what a difference between a grown mustard and a poppy plant! Not only flower and fruit but the whole plant assumes a particular shape and character differing externally as well, as in chemical constituents. We are forced to believe, that the cells, from which both plants originate, are endowed with a disposition forcing the growing organs to assume certain forms in accordance with a certain exchange of matter.

Such a disposition or plan of structure is inherent to every germ of plant and animal. Not the strongest microscope, nor any other means of observation have enabled us to ascertain the matter and processes upon which variation of development depends ; only this much has been established, that the faculty is particular to the germ itself, the forms resulting from the growth of a certain kind of germ invariably manifesting the same characters, independent from external influences. Soil, climate and light certainly modify the thriving of a plant, and, when unfavorable, can even prohibit growth, but the plant resulting nevertheless invariably shows the characters of the species to which it belongs. Neither in animal nor in plant, has domestication or horticulture ever generated a new species.

The author by these remarks does not intend to dispute the possibility and even probability, that new species have sprung from former ones in the course of unmeasurable past times; on the contrary, there are numerous geological, botanical and zoological facts known, which irresistibly point in that direction, but in historic time, i. e., during the last 5000 years, no evident change is known to have happened. Plants, animals and people represented on old Egyptian and Assyrian sculptures are exactly the same as those existing nowadays. The time, when linking forms between lizards and birds, as the pterodactylus, were living, lies in a remote past, and the origin of existing transient forms, as ornithorhynchus, lepidosiren and amphioxus may without scruples be dated back to periods preceding the appearance of man. Perfectly agreeing to the view adopted by most naturalists of our time, that plants as well as animals are the results of gradual evolution originating from monocellular organisms, we find it supported by the convincing argument of the descent of every single being from a minute fertilized cell, the embryo of man itself in its first stages closely resembling those of other animals, differences in the accomplishment of organs appearing in the advanced periods of growth.

By the comparison of any forms of higher animals including insects, evidence is given of a principle or type of symmetric structure common to all of them. There is a head provided with partly bilateral organs for the reception of objects and impressions from the outside and ending in a chord of nervous substance, the spine, located on the back or front side of the body, and dividing it into two longitudinal halves, to which the organs of movement are attached equally distributed on both sides, one side being the reverse of the other one. Similar pervading principles of structure are found in lower animals, more or less varying according to the classes and families to which the beings belong. The structural principles pervading the vegetable world are different, but not less evident and striking ones. One of the chief features in higher plants is the constant repetition of the same number, or a multiple of it in the parts of the flower and the fruit. In many families the number 5 is the predominating one, in others 6, or another amount in the parts of the calyx as well, as in the petala, stamina, stigmata and carpella. Perfect symmetry in the arrangement and division of organs also is frequently found in plants and beautifully exhibited in many forms of ferns.

Pursuing the enforcing faculty, the impulse or will in animals or plants to conduct the formation of organs in certain unvariable ways, independent from external influences, we find it concealed in the minute embryo from which all creatures originate. But we have to admit at the same time, that the researches hitherto performed on .this subject were but little successful, inasmuch as our knowleege in this respect is not much beyond that of our predecessors a century ago. They knew as well as we, that it is the germ or embryo, which is endowed with this power. The only apparent progress made is a hypothetical one, and consists in the prevailing opinion that in germination and growing, two different kinds of cells are active, some of them, the vegetative cells, being chiefly engaged in nutrition and growth, the others, or reproducing cells, for transferring to young individuals and preserving the character of the parents, family, tribe, etc. It is upon the presence of this last kind of cells—most frequent in reproductive organs—that the resemblance in members of families and nations and of genera and classes is believed to depend. Scientists attribute the reproductive faculty to the nucleus of protoplasma or albuminous matter found in these cells.

The growth of cells is a limited one. When a certain store of food has been taken up and a certain amount of protoplasma has been formed, the latter, forming the kernel or nucleus of the cell, receives a gradually increasing stricture, dividing it into two halves, which finally separate; the stricture extends to the whole cell, which by division gives rise to two new cells perfectly resembling the mother cell as to form, organization and general characters. In this way multiplication of all reproducing cells takes place, including that of micro-organisms; it is the simplest and primitive way of generation of new individuals. We see, that the progress of our knowledge in this question is limited to the fact, that while formerly the embryo as a whole was regarded as the agent at once reproducing and preserving the original form, these functions nowadays are attributed to a certain class of its constituting cells, or rather to the protoplasma which they contain.

But a scanty comfort it is, that this theory affords to our mind eager to penetrate into this apparently unfathomable secret of nature, intimately connected with the question for the origin of life itself; but notwithstanding its deficiencies, the hypothesis of reproducing cells well explains the resemblance commonly existing between members of one family, its increasing in nearly related individuals and its diminishing by the interference of strange elements.

If permitted to consider the "cell" as the elementary organ in animals and vegetables, we are as well justified to attribute the same roll in the mineral world to the "crystal." There is no mineral substance existing which is not known to crystallize under certain circumstances, and the formation of cells in plants from the constituents of their juices, the secretion of muscular fibre from albuminous matter in blood, stands in closer relation to the separation of crystals from solutions, than is generally imagined. Who, when on a cold winter morning, finding the panes of his windows covered with ice-crystals shaped like luxurious ferns, mosses or twigs of pine trees, was not impressed with the conjecture of a relation between the phenomena of organization and crystallization of some common occult force giving form to organic as well as to nonorganic matter? Indeed, there are no strict limits existing between organization and crystallization. The curved line and surface may be regarded as particular to and characteristic of organic matter, the straight line and surface of mineral substances, but there are innumerable exceptions exhibiting the former in well defined crystals, while crystals of minerals frequently occur having curved surfaces. Thus the crystals of pyromorphite, chiefly consisting of phosphate of lead, are polyhedra with curved planes, and compounds of hydroxylamine with certain oxides of metals have hemispheric forms. The starch grain may be considered as the connecting link between both morphological classes, the round form on the one hand indicating a cell like character, its growing by attachment of layers on its outside on the other hand, perfectly agreeing with the way in which crystals are observed to grow.

It is in three states that solid matter is known to occur, in the amorphous, the crystalline and the organized states. The amorphous seems to be the original one, since the others are generally found to originate from it, the reverse but exceptionally taking place. The best known amorphous substance is glass, in which in its perfect state no crystalline particles can be discovered. Resins, such as colophony and copal, and Indian rubber are amorphous, as well as glue and molten sugar in its fresh state. In sugar the liability to pass into the crystalline state is very prominent; sometimes a few minutes after its cooling the transparent mass becomes opaque by the separation of minute crystals of sugar. Crystallization frequently sets in in some varieties of glass, particularly when rapidly cooled. Albumen is the principal amorphous substance in living animals from which organized matter is derived.

A striking difference of amorphous and crystalline matter is manifested in the behavior of their solutions. Amorphous matter soluble in water, when dissolved gives viscid or gelatinous liquids, their thickness increasing with the lessening amount of water present. No compounds with water in definite proportions seem to be existing. Solutions of crystalline matter, on the contrary, are thin as water; when concentrated to a certain point crystals of solid matter begin to separate. Crystallization sometimes sets in suddenly, the whole liquid turning into a magma of small solid particles suspended in the fluid. The solution contains compounds with water in definite proportions. When evaporating a solution of red cobalt chloride, it suddenly turns blue, which happens in the moment when more water has been removed, than the red salt needs for its existence.

Having tried to explain the resemblance in the features of related organisms by the prevailing of particular cells reproducing by unknown impulses the same character in every new individual, we feel induced to look for the cause of the well known fact, that mineral matter is subject to similar constraints, being forced, when crystallizing, to assume certain invariable forms. Every crystalline body has its peculiar shape varying only by the addition of planes belonging to forms of the same system. Compounds of different ingredients, but of similar constitution, are frequently found to appear in the same forms, as is seen in the class of compounds comprised by the name of "alum." Whenever a body is found crystallizing in several systems, a chemical difference, although perhaps a slight one, may generally be assumed. But in identical bodies polymerisation, or multiplication of atoms in a molecule, is a frequent cause of variations in form. It is one of the merits of the new doctrine of stereo-chemistry to have given the hint, that molecules of compounds as well as of elementary bodies, contain their atoms arranged in certain directions given by the prevailing chemical attractions. In accordance with this view every molecule may be represented by a certain stereometric form, be it a tetrahedron, an octahedron, a cube, etc. The attractions diverting accumulation of atoms in a molecule also govern the attractions uniting the molecules to visible crystalline individuals. The effects of such attractions are even frequently extended to the position of the crystals to each other. Every snow flake represents a system of symmetrically arranged numerous hexagonal ice crystals, the hexagonal form not only dominating in the single crystals, but being evidently noticeable in the whole beautiful arrangement. Common salt, when crystallizing from saturated solutions, is seen to separate in amphitheatrical square combinations consisting of single cubical salt particles. In the single crystals, as well as in their congregations, we observed the square predominating as the elementary form.

Neither in the manifold features of animal and plant life, nor in the crystalline formations of mineral matter, are external influences deciding as to the forms to be adopted. Individuals of different natural character of different species, grow up and become differently shaped, although exposed to the same external conditions. A slight transforming influence of temperature, light, food and contact cannot be denied, but the preservation of existing types of species and genera in all three natural worlds is the effect of unknown forces independently acting in reproductive cells and organs, as well as in mineral atoms and molecules. If we may expect ever to notice the formation of a new species under our eyes, this event will not depend upon external conditions, but upon a change in the nature of protoplasma, or of the chemical structure of a mineral molecule. The author does not doubt that such changes are continually going on in nature, but they are too slow and subtile to be accessible to our observation. The chief part in such changes will always be due to agents or forces peculiar to the elementary organs and exerting impulses, by which permanent forms are resulting.

CONTRIBUTIONS TO COCCIDOLOGY.—II.

By T. D. A. Cockerell, Mesilla, New Mexico.

No. I appeared in American Naturalist, Aug., 1895, pp. 725–732.

(1). *Icerya rileyi* Ckll. In September, 1893, I bred a *Lætilia* from a larva living on *I. rileyi* on mesquite at Las Cruces, N. M. The Rev. G. D. Hulst informed me that it was "different from *coccidivora* and from *L. ephestiella*, a good variety at least." It may, therefore, be as well to put its characters on record:—

Lætilia coccidivora var. *hulstii*, n. var.—Palpi ascending; fore wings gray, brownish at extreme base and beyond the first band. The first band, at end of basal third, double, consisting of a gray line bordered without by a white band. A wavy band consisting of two blackish lines not far from the exterior margin. Hind wings shining white; abdomen above whitish, banded with gray. It would seem to connect *coccidivora* with *ephestiella*, and so, perhaps, all are varieties of one.

(2). *Rhizococcus* (?) *devoniensis* Green, Ent. Record, 1896, p. 260. I should certainly prefer to call this *Eriococcus devonien-*